

ETHEOSTOMA AQUALI, A NEW PERCID FISH (SUBGENUS
NOTHONOTUS) FROM THE DUCK AND
BUFFALO RIVERS, TENNESSEE

James D. Williams and David A. Etnier

Abstract.—*Etheostoma aquali*, a new percid fish, is described from the Duck and Buffalo rivers, tributary to the Tennessee River in central Tennessee. It is compared to *Etheostoma maculatum sanguifluum* from the Cumberland River System in Tennessee and Kentucky. The new species differs from other species of the subgenus *Nothonotus* in details of squamation and pigmentation. Recent distribution records of three species of the subgenus *Nothonotus* are reported.

During the past 15 years the rather considerable research conducted on the systematics of darters of the subgenus *Nothonotus* (genus *Etheostoma*) has resulted in the description of five new species. This research was summarized by Zorach (1972) who discussed relationships within the subgenus. In this paper we describe the coppercheek darter, a new species, from the Duck and Buffalo river systems, Tennessee River drainage, Tennessee. This brings the number of species assigned to the subgenus *Nothonotus* to twelve. The three allopatric subspecies of *Etheostoma maculatum* may eventually be recognized as species. In addition, extant specimens from collections taken some years ago may represent undescribed taxa that have been eliminated or drastically reduced by impoundments and decreasing water quality (see Zorach, 1972:431, and Distribution section in this paper).

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Comparative material of *E. m. maculatum*, *E. m. vulneratum*, and *E. m. sanguifluum* from the UAIC, USNM, and UT collections was utilized in preparing this description. One to three collections of all species of the subgenus *Nothonotus* were examined for various meristic, pigmentation, and squamation characteristics during the course of the study. Methods

of Hubbs and Lagler (1958) were used in obtaining counts and measurements except diagonal scale counts (anal fin to first dorsal fin and second dorsal fin to anal fin) described by Raney and Suttkus (1964). Vertebral counts follow Bailey and Gosline (1955).

Etheostoma aquali, new species
Coppercheck Darter
(Fig. 1)

Etheostoma microlepidum. Raney and Zorach, 1967:93-94, 97-98, 103. Misidentification of specimens from the Duck River, Tennessee River drainage.

Etheostoma sp. Zorach, 1972:445. Undescribed species from Duck River system.

Holotype.—Adult male, TU 105479, 55 mm standard length (SL), Flat Creek, tributary to Duck River at Tennessee Highway 64, Bedford Co., Tennessee, 13 April 1967.

Allotype.—Adult female, TU 105480, 43 mm SL, taken with holotype.

Paratopotypes.—Paratypes taken with primary types are TU 105481 (3). Additional paratypes taken at the type-locality are USNM 218001 (6), 1 October 1967; UAIC 2826 (6), 3 February 1968; and UAIC 2856 (1), 29 March 1968.

Other paratypes.—Duck River system, Tennessee: UAIC 2700 (18), Duck River at Shelbyville, Bedford Co., 1 October 1967; UT 91.228 (7), Duck River at U.S. Highway 231, Shelbyville, Bedford Co., 20 October 1968; TU 32989 (6), Duck River 13.4 miles NW of Tullahoma on U.S. Highway 41A, Bedford Co., 17 July 1964; UT 91.749 (1), Duck River at Cortners Mill, River Mile 245, Bedford Co., 4 October 1972; TU 95729 (1), Duck River below bridge just above mouth of Buffalo River, Humphreys Co., 10 September 1975; Illinois Natural History Survey 77826 (3), Duck River at mouth of Hurricane Creek, Humphreys Co., 29 August 1973; Florida State Museum 24499 (9), Duck River at first bridge above I-40, one river mile above I-40, Hickman Co., 10 October 1972; University of Michigan Museum of Zoology (UMMZ) 201716 (1), Duck River at I-40 crossing, Hickman Co., 10 March 1968. Buffalo River system, Tennessee: UMMZ 201717 (2), Buffalo River at mouth of Grinders Creek, Lewis Co., 10 July 1970; UT 91.1282 (5), same locality, 27 April 1974; UT 91.622 (1), Buffalo River at Perry Co. 6242, SE of Lobelville, 8 September 1971; USNM 218002 (2), Buffalo River at Metal Ford, River Mile 100, about 2 miles above mouth of Grinders Creek, Lewis Co., 22 July 1976.

Diagnosis.—*Etheostoma aquali* is a member of the *E. maculatum* species group (Zorach, 1972:442) of the subgenus *Nothonotus*. It differs from *E. acuticeps* in having the opercles and anterodorsal portions of cheeks scaled.



Fig. 1. *Etheostoma aquali* new species, paratype, UT 91.1282, male, 64 mm SL.

Black marginal bands present on the anal, caudal, and soft-rayed dorsal fins of *E. maculatum vulneratum**, *E. microlepidum*, *E. moorei*, and *E. rubrum* males are lacking in *E. aquali*. Differs from *E. m. maculatum* in having red or orange in the anal fin (males only). Most similar to and probably most closely related to *E. maculatum sanguifluum*, from which it differs in having wavy copper-colored lines on the cheeks of both sexes and in lacking a dark suborbital bar. In *E. m. sanguifluum* the coppery lines are absent and a suborbital bar is present. In males of *E. aquali* bright red spots on the sides are usually restricted to the posterior three-fourths of the body, whereas in all subspecies of *E. maculatum* these red spots extend forward to the head. Females of *E. aquali* appear to resemble those of *E. m. maculatum* in not developing red spots on the sides; these spots are typically detectable in *E. m. sanguifluum* and *E. m. vulneratum*. Lateral-line scales (Table 2) average 62 (57–67) in *E. aquali* and 58 (51–67) in *E. m. sanguifluum*.

Description.—*Etheostoma aquali* is a robust, moderate to large species (Fig. 1) of the subgenus *Nothonotus*. The largest specimen we have seen is a male 67 mm SL; adult males are typically about 60 mm SL. Adult females are typically about 50 mm SL, with the largest seen up to 56

Table 1. Measurements in thousands of SL of *Etheostoma aquali* new species. \bar{x} = mean, W = range of values.

	TU 105479 holotype	USNM 218001, FSM 24499 UT 91.1282 5 ♂		USNM 218001, FSM 24499 UT 91.1282 5 ♀	
		\bar{x}	W	\bar{x}	W
Standard length	55.2	61.6	58.5-65.7	50.6	45.1-55.2
Body depth dorsal origin	237	230.0	220-245	209.4	189-233
Caudal peduncle depth	141	144.4	138-161	127.6	109-140
Caudal peduncle length	204	209.1	203-222	201.2	166-221
Pelvic fin length	172	179.6	174-189	183.4	146-199
Pectoral fin length	207	206.0	198-211	211.4	189-225
Head length	265	251.2	242-256	253.2	224-265
Snout length	74	64.8	60-68	64.0	58-71
Orbit length	62	59.2	56-62	59.8	55-64
Upper jaw length	90	84.2	80-91	80.2	72-86
Longest dorsal spine	123	137.8	129-147	130.6	115-156
Longest dorsal ray	156	155.6	145-162	135.0	115-146
1st anal spine	89	92.2	85-101	93.0	86-100
Longest anal ray	138	142.6	131-149	130.2	117-142

mm SL. Greatest body depth just anterior to spinous dorsal fin; greatest body width just posterior to opercle. Morphometric data appear in Table 1.

Lateral line complete with 57-62 (\bar{x} = 62.2, holotype = 60) scales (see Table 2). Diagonal scale count from origin of soft dorsal fin to anal fin base 13-17 (14.95, 14). Caudal peduncle scale rows 21-26 (22.3, 22). Diagonal scale count from anal fin origin to base of dorsal fin 16-20 (17.9, 16). Scale rows above lateral line 5-8 (6.9, 7, see Table 2).

Dorsal fin with XII-XIV (12.9, 12) spines and 11-14 (12.7, 13) soft rays. Total dorsal rays 24-27 (25.5, 25, see Table 3). Anal rays 8-10 (9.2, 10, see Table 3). Pectoral rays 12-16 (13.6, 14). Vertebrae 38-40 (38.96, 39).

Cephalic sensory canals typically with little variation between left and right sides. Pore counts (left side of 25 individuals) are as follows: supratemporal canal with 3 pores; lateral canal pores 5 (23 specimens) or 6 (2); supraorbital canal pores 3; coronal pore single; infraorbital canal pores 8 (24) or 9 (1); preoperculomandibular canal pores 10 (24) or 11 (1). Gill membranes separate; branchiostegal rays 6-6. Frenum broad.

Body scaled except for nape, prepectoral area, breast, and occasionally anterior portion of belly. Opercles completely scaled, scales absent elsewhere on head. Cheeks with about 3-5 ctenoid (occasionally cycloid) scales associated with dark spot behind eye. Zorach (1972:430) noted the presence of these scales in *E. moorei* and *E. rubrum*. We find them to also be con-

Table 2. Frequency distribution of selected scale counts in *Etheostoma aquali* and *E. maculatum sanguifluum*. Counts for *E. maculatum sanguifluum* from Zorach and Raney (1967).

	Lateral line scales																	\bar{x}
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	
<i>E. aquali</i>							1	1	3	7	17	6	6	4	6	3	3	62.18
<i>E. m. sanguifluum</i>	1		1	5	4	6	8	4	10	8	5	2	1	1		1		58.07

	Scales above lateral line					\bar{x}	
	5	6	7	8	9		
<i>E. aquali</i>		3	14	21	14	6.89	
<i>E. m. sanguifluum</i>			2	27	24	4	7.53

sistently present in *E. microlepidum* and the three subspecies of *E. maculatum*. They are absent in other species of *Nothonotus* and in *E. juliae*, a species which may have affinities with *Nothonotus*.

Coloration.—Life colors of males and females collected in February, April, July, and October showed little seasonal variation. Males (Fig. 1) with body grayish to dark olive brown. Dark horizontal lines between scale rows conspicuous on caudal peduncle, extending slightly forward of anal fin below lateral line and to under middle of spinous dorsal fin above lateral line. About 20–35 bright red spots on sides, these spots approximately equal in number above and below lateral line. Each spot confined to area between horizontal lines and occupying much of exposed field of single scales or occasionally two scales in horizontal series. Humeral scale iridescent greenish black. Belly grayish brown. Breast grayish. Gill membranes darker than breast. Cheeks with 2–3 characteristic copper-colored lines (occasionally broken into a series of dashes) that extend, with less intensity, onto opercles. Position, width, and intensity of marks on head somewhat variable. Most prominent mark extends from above angle of jaw posteriodorsad to near junction of preopercle and opercle, where it splits, forming 2 distinct lines. Upper line extends posteriad across upper part of opercle, terminating near dorsal base of opercular spine. Lower line extends posteroventrally, terminating near middle of suboperculum. Another mark, usually less prominent, extends from behind and slightly below angle of jaw posteriad across cheek, its continuation on gill cover at symphysis of suboperculum and interoperculum. In some individuals 2–3 additional copper dashes extend from posteroventral margin of orbit across upper margin of cheek and opercle. Small copper-colored spots may occur on snout and interorbital area, these spots occasionally confluent. Dark preorbital bars extend ventral to nares and terminate immediately.

Table 3. Frequency distribution of selected fin-ray counts on *Etheostoma aquali* and *E. maculatum sanguifluum*. Counts for *E. maculatum sanguifluum* from Zorach and Raney (1967).

	Total dorsal rays					\bar{x}
	23	24	25	26	27	
<i>E. aquali</i>		4	24	25	5	25.53
<i>E. m. sanguifluum</i>	2	10	35	8	2	24.97

	Anal rays				\bar{x}
	7	8	9	10	
<i>E. aquali</i>		2	42	15	9.22
<i>E. m. sanguifluum</i>	4	40	12	1	8.18

lateral to frenum. Spinous dorsal fin dark olive to dark gray at base and progressively paler toward clear margin. Proximal half of first one or two interradiial membranes darker than posterior membranes. Distal halves of first and last membranes (and often 1-2 adjacent membranes) bright red. Base of soft dorsal fin dark olive green grading to grayish orange toward the narrow, clear margin. Some individuals with slashes of reddish interradiial pigment in central portion of fin. Basal one-fourth of anal fin dark olive to dark gray. Distal three-fourths of fin bright red except for narrow margin which is white anteriad, becoming clear posteriad. Bright red pigment of anal fin covers both rays and membranes on anterior two-thirds of fin; on remainder of fin red confined primarily to membranes. Caudal fin with narrow clear margin; bright red on 2-3 principal dorsal and ventral rays and associated membranes. Distal three-fourths of middle 8-10 caudal rays and membranes with red slightly less intense than adjacent dorsal and ventral areas. Basal fourth of middle 8-10 caudal rays dark olive, forming a quadrate blotch at base of fin. Procurrent caudal rays dark olive. Pectoral fins with grayish to dark olive base gradually changing to reddish orange (primarily on membranes) toward margin. Pelvic fins bright red with dark olive to grayish base. Pelvic spine white to cream colored.

Female bodies olivaceous with scattered brownish to dark gray blotches. Horizontal dark lines between scale rows less conspicuous than on males, typically not extending forward of anal and soft dorsal fin, and occasionally obsolescent. Red spots have not been observed on females. Belly, breast, and opercular membranes olive to grayish. Cheeks and opercles dark olive to light brown, with cheeks paler than opercles and marked with copper-colored reticulations that tend to be less bold than those of males. Median fins pale yellow, occasionally tinged with green, and liberally

covered with dark olive to dark gray spots. Spots on soft dorsal and anal fins scattered on rays and membranes. Spinous dorsal fin with distinct spots conspicuous near margin, pigment more uniform toward base of fin. Caudal fin spots confined to rays, arranged in 5-6 irregular vertical rows. Base of caudal fin with dorsal and ventral pale areas separated by median dark mark or pair of adjacent submedian dark marks. Spots on pectoral and pelvic fins aligned in irregular vertical rows, restricted to rays of former and occurring on both rays and membranes of latter. Varying amounts of light reddish orange pigment occasionally present on paired and/or median fins of some individuals.

Distribution and habitat.—The coppercheek darter is known only from the Duck and Buffalo rivers, tributaries to the Tennessee River in central Tennessee. Within the Duck River it occurs only in the main channel and lower portions of a few larger tributaries in Bedford, Maury, Hickman, and Humphreys counties. In the Buffalo River, it has been taken only in the main channel in Lewis, Wayne, and Perry counties. *Etheostoma aquali* has been confused with other species of the subgenus *Nothonotus*. The record of *E. microlepidum* (TU 32989) reported from the Duck River by Raney and Zorach (1967) was based on specimens of *E. aquali*, as pointed out by Zorach (1972:445). Gilbert's (1891) record of *E. maculatum* from the Duck River is probably based on specimens of *E. aquali*, but this could not be confirmed since these specimens are apparently lost. Raney and Zorach (1967) examined the 5 specimens in USNM 36670, taken in Shoal Creek, Florence, Alabama, in 1884 by Gilbert and Swain, and identified 3 as *E. rufilineatum* and 2 as *E. microlepidum*. In 1972, Zorach realized that the Duck River specimens identified earlier as *E. microlepidum* represented an undescribed species. We have reexamined these specimens and are of the opinion that the two specimens identified as *microlepidum* are neither that species nor are they *E. maculatum vulneratum* or *E. aquali*. This conclusion is based primarily on the absence of scales behind the eye in both specimens. These two specimens (USNM 36670) along with a single specimen (TU 30271) from the Elk River at Fayetteville, Lincoln Co., Tenn., may represent an undescribed taxon. All three specimens are from the same geographic area and have similar meristics and squamation. Body shape, pigmentation, and the presence of 63-64 lateral scale rows in the specimens suggests that their affinities are with the *E. maculatum* species group. While these populations may be extinct, we believe that additional collecting effort in the southern bend of the Tennessee River drainage in northern Alabama and southern Tennessee may provide fresh material which hopefully would clarify the status of the Shoal Creek and Elk River specimens. The scarcity of material may be due in part to the difficulty of adequately sampling the large stream habitat typically occupied by the subgenus. This may also account for *E. tippecanoe* (Bedford Co.) and

E. camurum (Maury Co.) being taken recently in the Duck River after many years of collecting effort. Similarly, *E. microlepidum* was recently taken for the first time from the Red River in Robertson Co., Tenn. The habitat of *E. aquali* is similar to that described for the subspecies of *E. maculatum*. It is typically taken from large streams and rivers in shoal areas 0.3–1 m deep with moderate to swift current. Substrate is typically a mixture of gravel and cobbles with some large, unconsolidated rocks. The coppercheek darter is most often found among the large rocks.

Conservation.—The coppercheek darter is presently protected as a threatened species by Tennessee and is being considered for similar status by the Department of Interior, U.S. Fish and Wildlife Service. The recently completed Normandy Dam in the upper Duck River is expected to reduce or eliminate populations in the vicinity of the dam. The controversial Columbia Dam, currently being built on the middle portion of the Duck River, will eliminate populations in that area. It is not possible to predict the precise effect of discharges from a completed Columbia Reservoir on the extremely diverse and complex riverine fauna occupying the approximately 120 river miles of the Duck River below Columbia Dam site. We can be assured that the net effect will be a reduction of species diversity. Since endangered and threatened species often achieve that status because of their inability to cope with habitat alteration, we expect this loss of species diversity to have a disproportionately adverse effect on the threatened fishes and endangered and threatened mollusks of the river. Members of the subgenus *Nothonotus* are not tolerant of reservoirs and appear to have only limited tolerance of tailwater habitats. Portions of the Duck River, and to a lesser extent the Buffalo River, are also suffering from the polluting effects of inadequately treated industrial and municipal sewage.

Etymology.—The species epithet, *aquali*, is suggested by and shortened from the Cherokee word “agaquali,” which, according to Alexander (1971) means “cheek.” Its use is intended to call attention to the cheek region which in life has copper-colored markings that are a diagnostic feature of the species.

Literature Cited

- Alexander, J. T. 1971. A dictionary of the Cherokee Indian Language. Sperry, Oklahoma. 359 pp.
- Bailey, R. M., and W. A. Gosline. 1955. Variation and systematic significance of vertebral counts in the American fishes of the family Percidae. Misc. Pub. Mus. Zool. Univ. Mich. 93:1–44.
- Gilbert, C. H. 1891. Report of explorations made in Alabama during 1889, with notes on the fishes of the Tennessee, Alabama, and Escambia rivers. Bull. U.S. Fish Comm. 9:143–160.
- Hubbs, C. L., and K. F. Lagler. 1958. Fishes of the Great Lakes Region. Cranbrook Inst. Sci. Bull. 26:1–213.

- Raney, E. C., and R. D. Suttkus. 1964. *Etheostoma moorei*, a new darter of the subgenus *Nothonotus* from the White River System, Arkansas. *Copeia* 1964(1): 130-139.
- Raney, E. C., and R. Zorach. 1967. *Etheostoma microlepidum*, a new percid fish of the subgenus *Nothonotus* from the Cumberland and Tennessee River systems. *Am. Mid. Nat.* 77:93-103.
- Zorach, T., and E. C. Raney. 1967. Systematics of the percid fish, *Etheostoma maculatum* Kirtland, and related species of the subgenus *Nothonotus*. *Am. Mid. Nat.* 77:296-322.
- Zorach, T. 1972. Systematics of the percid fishes, *Etheostoma camurum* and *E. chlorobranchium* new species, with a discussion of the subgenus *Nothonotus*. *Copeia* 1972(3):427-447.

(JDW) Office of Endangered Species, Fish and Wildlife Service, Department of the Interior, Washington, D.C. 20240; and (DAE) Department of Zoology, University of Tennessee, Knoxville, Tennessee 37916.

Footnote

* John Ramsey has correctly pointed out (in Lit.) that part of the color description of *E. m. vulneratum* (Zorach and Raney, 1967:318) is based on his color notes for *E. chlorobranchium* (JSR field notes 63-24) rather than his notes for *E. m. vulneratum* (JSR 63-19). In particular the sentence describing the median fins as having a "black margin bordered by lemon-yellow," and the preceding and following sentence clearly pertain to *E. chlorobranchium* and not to *E. m. vulneratum*.